Instructor's Solutions Manual
to accompany

INTRODUCTORY CIRCUIT ANALYSIS

Tenth Edition

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Contents

CHAPTER 1 (Odd)

5. $12\,\cancel{\text{mi}}\left[\frac{15\ \cancel{\text{min}}}{\cancel{\text{mi}}}\right]\left[\frac{1\ \text{h}}{60\ \cancel{\text{min}}}\right] = \mathbf{3\ h}$

7. CGS

9. MKS, CGS: $°C = \frac{5}{9}(°F - 32) = \frac{5}{9}(68 - 32) = \frac{5}{9}(36) = \mathbf{20°}$
   K: $K = 273.15 + °C = 273.15 + 20 = \mathbf{293.15}$

11. $0.5\,\cancel{\text{yd}}\left[\frac{3\ \cancel{\text{ft}}}{1\ \cancel{\text{yd}}}\right]\left[\frac{12\ \cancel{\text{in.}}}{1\ \cancel{\text{ft}}}\right]\left[\frac{2.54\ \text{cm}}{1\ \cancel{\text{in.}}}\right] = \mathbf{45.72\ cm}$

13. a. $\mathbf{15 \times 10^3}$ b. $\mathbf{30 \times 10^{-3}}$ c. $\mathbf{7.4 \times 10^6}$
    d. $\mathbf{6.8 \times 10^{-6}}$ e. $\mathbf{402 \times 10^{-6}}$ f. $\mathbf{200 \times 10^{-12}}$

15. a. $(10^2)(10^2) = \mathbf{10^4}$ b. $(10^{-2})(10^3) = \mathbf{10}$ c. $\mathbf{10^9}$
    d. $(10^3)(10^{-5}) = \mathbf{10^{-2}}$ e. $(10^{-6})(10 \times 10^6) = \mathbf{10}$ f. $(10^4)(10^{-8})(10^{35}) = \mathbf{10^{31}}$

17. a. $\frac{10^2}{10^3} = \mathbf{10^{-1}}$ b. $\frac{10^{-2}}{10^2} = \mathbf{10^{-4}}$ c. $\frac{10^4}{10^{-5}} = \mathbf{10^9}$
    d. $\frac{10^{-7}}{10^2} = \mathbf{10^{-9}}$ e. $\frac{10^{38}}{10^{-4}} = \mathbf{1042}$ f. $\frac{(10^2)^{1/2}}{10^{-2}} = \frac{10^1}{10^{-2}} = \mathbf{10^3}$

19. a. $(10^2)^3 = \mathbf{10^6}$ b. $(10^{-4})^{1/2} = \mathbf{10^{-2}}$
    c. $(10^4)^8 = \mathbf{10^{32}}$ d. $(10^{-7})^9 = \mathbf{10^{-63}}$

21. a. $(-10^{-3})^2 = 10{-}6$ b. $\frac{(10^2)(10^{-4})}{10} = \frac{10^{-2}}{10} = \mathbf{10^{-3}}$
    c. $\frac{(10^{-3})^2(10^2)}{10^4} = \frac{(10^{-6})(10^2)}{10^4} = \frac{10^{-4}}{10^4} = \mathbf{10^{-8}}$ d. $\frac{(10^2)(10^4)}{10^{-3}} = \frac{10^6}{10^{-3}} = \mathbf{10^9}$
    e. $\frac{(10^{-4})^3(10^2)}{10^6} = \frac{(10^{-12})(10^2)}{10^6} = \frac{10^{-10}}{10^6} = \mathbf{10^{-16}}$
    f. $\frac{\left[(10^2)(10^{-2})\right]^{-3}}{\left[(10^2)^2\right][10^{-3}]} = \frac{1}{(10^4)(10^{-3})} = \frac{1}{10} = \mathbf{10^{-1}}$

23. a. $6 \times 10^{3} = \underline{0.006} \times 10^{+6}$ (+3 over; −3 under)

b. $4 \times 10^{-4} = \underline{400} \times 10^{-6}$ (−3 over; +3 under)

c. $50 \times 10^{5} = \underline{5000} \times 10^{3} = \underline{5} \times 10^{6} = \underline{0.005} \times 10^{9}$ (−2, +3, +3 over; +2, −3, −3 under)

d. $30 \times 10^{-8} = \underline{0.0003} \times 10^{-3} = \underline{0.3} \times 10^{-6} = \underline{300} \times 10^{-9}$ (+5, −3, −3 over; −5, +3, +3 under)

25. a. $1.5 \text{ min}\left[\frac{60 \text{ s}}{1 \text{ min}}\right] = \mathbf{90 \text{ s}}$

b. $0.04 \text{ hr}\left[\frac{60 \text{ min}}{1 \text{ hr}}\right]\left[\frac{60 \text{ s}}{1 \text{ min}}\right] = \mathbf{144 \text{ s}}$

c. $0.05 \text{ s}\left[\frac{1 \ \mu\text{s}}{10^{-6} \text{ s}}\right] = 0.05 \times 10^{6} \ \mu\text{s} = \mathbf{50 \times 10^{3} \ \mu s}$

d. $0.16 \text{ m}\left[\frac{1 \text{ mm}}{10^{-3} \text{ m}}\right] = 0.16 \times 10^{3} \text{ mm} = \mathbf{160 \text{ mm}}$

e. $1.2 \times 10^{-7} \text{ s}\left[\frac{1 \text{ ns}}{10^{-9} \text{ s}}\right] = 1.2 \times 10^{2} \text{ ns} = \mathbf{120 \text{ ns}}$

f. $3.62 \times 10^{6} \text{ s}\left[\frac{1 \text{ min}}{60 \text{ s}}\right]\left[\frac{1 \text{ hr}}{60 \text{ min}}\right]\left[\frac{1 \text{ day}}{24 \text{ hr}}\right] = \mathbf{41.898 \text{ days}}$

g. $1020 \text{ mm}\left[\frac{10^{-3} \text{ m}}{1 \text{ mm}}\right] = \mathbf{1.02 \text{ m}}$

27. a. $100 \text{ in.}\left[\frac{1 \text{ m}}{39.37 \text{ in.}}\right] = \mathbf{2.54 \text{ m}}$

b. $4 \text{ ft}\left[\frac{12 \text{ in.}}{1 \text{ ft}}\right]\left[\frac{1 \text{ m}}{39.37 \text{ in.}}\right] = \mathbf{1.219 \text{ m}}$

c. $6 \text{ lb}\left[\frac{4.45 \text{ N}}{1 \text{ lb}}\right] = \mathbf{26.7 \text{ N}}$

d. $60 \times 10^{3} \text{ dynes}\left[\frac{1 \text{ N}}{10^{5} \text{ dynes}}\right]\left[\frac{1 \text{ lb}}{4.45 \text{ N}}\right] = \mathbf{0.1348 \text{ lb}}$

e. $150{,}000 \text{ cm}\left[\frac{1 \text{ in.}}{2.54 \text{ cm}}\right]\left[\frac{1 \text{ ft}}{12 \text{ in.}}\right] = \mathbf{4921.26 \text{ ft}}$

f. $0.002\ \text{mi}\left[\frac{5280\ \text{ft}}{1\ \text{mi}}\right]\left[\frac{12\ \text{in.}}{1\ \text{ft}}\right]\left[\frac{1\ \text{m}}{39.37\ \text{in.}}\right] = \mathbf{3.2187\ m}$

g. $7800\ \text{m}\left[\frac{39.37\ \text{in.}}{1\ \text{m}}\right]\left[\frac{1\ \text{ft}}{12\ \text{in.}}\right]\left[\frac{1\ \text{yd}}{3\ \text{ft}}\right] = \mathbf{8530.17\ yds}$

29. $299{,}792{,}458\ \frac{\text{m}}{\text{s}}\left[\frac{39.37\ \text{in.}}{1\ \text{m}}\right]\left[\frac{1\ \text{ft}}{12\ \text{in.}}\right]\left[\frac{1\ \text{mi}}{5280\ \text{ft}}\right]\left[\frac{60\ \text{s}}{1\ \text{min}}\right]\left[\frac{60\ \text{min}}{1\ \text{h}}\right]$
$= 670{,}615{,}288.1\ \text{mph} \cong \mathbf{670.62 \times 10^6\ mph}$

31. $100\ \text{yds}\left[\frac{3\ \text{ft}}{1\ \text{yd}}\right]\left[\frac{1\ \text{mi}}{5280\ \text{ft}}\right] = 0.0568\ \text{mi}$

$t = \frac{d}{v} = \frac{0.0568\ \text{mi}}{\frac{100\ \text{mi}}{\text{h}}} = 0.0568 \times 10^{-2}\ \text{h}\left[\frac{60\ \text{min}}{1\ \text{h}}\right]\left[\frac{60\ \text{s}}{1\ \text{min}}\right] = \mathbf{2.045\ s}$

33. $\frac{50\ \text{m}}{\text{min}}\left[\frac{60\ \text{min}}{1\ \text{h}}\right]\left[\frac{39.37\ \text{in.}}{1\ \text{m}}\right]\left[\frac{1\ \text{ft}}{12\ \text{in.}}\right]\left[\frac{1\ \text{mi}}{5280\ \text{ft}}\right] = 1.86\ \text{mi/h}$

$t = \frac{d}{v} = \frac{3000\ \text{mi}}{1.86\ \frac{\text{mi}}{\text{h}}} = 1612.9\ \text{h} = \mathbf{67.2\ days}$

35. $100\ \text{yds}\left[\frac{3\ \text{ft}}{1\ \text{yd}}\right]\left[\frac{12\ \text{in.}}{1\ \text{ft}}\right] = 3600\ \text{in.} \Rightarrow 3600\ \text{quarters} = \mathbf{\$900}$

37. $d = vt = \left[600\frac{\text{cm}}{\text{s}}\right][0.016\ \text{h}]\left[\frac{60\ \text{min}}{1\ \text{h}}\right]\left[\frac{60\ \text{s}}{1\ \text{min}}\right]\left[\frac{1\ \text{m}}{100\ \text{cm}}\right] = \mathbf{345.6\ m}$

39. $d = (86\ \text{stories})\left[\frac{14\ \text{ft}}{\text{story}}\right] = 1204\ \text{ft}\left[\frac{1\ \text{mile}}{5{,}280\ \text{ft}}\right] = 0.228\ \text{miles}$

$\frac{\text{min}}{\text{mile}} = \frac{10.7833\ \text{min}}{0.228\ \text{miles}} = \mathbf{47.30\ min/mile}$

41. a. $5\ \text{J}\left[\frac{1\ \text{Btu}}{1054.35\ \text{J}}\right] = \mathbf{4.74 \times 10^{-3}\ Btu}$

b. $24\ \text{ounces}\left[\frac{1\ \text{gallon}}{128\ \text{ounces}}\right]\left[\frac{1\ \text{m}^3}{264.172\ \text{gallons}}\right] = \mathbf{7.098 \times 10^{-4}\ m^3}$

c. $1.4\ \text{days}\left[\frac{86{,}400\ \text{s}}{1\ \text{day}}\right] = \mathbf{1.2096 \times 10^5\ s}$

d. $1\ \text{m}^3\left[\frac{264.172\ \text{gallons}}{1\ \text{m}^3}\right]\left[\frac{8\ \text{pints}}{1\ \text{gallon}}\right] = \mathbf{2113.38\ pints}$

43. [2nd F] [$\sqrt{}$] [(] [3] [x^2] [+] [4] [x^2] [)] [ENTER] $\Rightarrow \mathbf{5.000}$

45. [2nd F] [$\sqrt{}$] [(] [4] [0] [0] [÷] [(] [6] [x^2] [+] [1] [0] [)] [)] [ENTER] $\Rightarrow \mathbf{2.949}$

CHAPTER 1 (Even)

4. $50\frac{\text{mi}}{\text{hr}}\left[\frac{5280\text{ ft}}{1\text{ mi}}\right]\left[\frac{1\text{ hr}}{60\text{ min}}\right] = 4400\text{ ft/min}$

$d = vt = \left[\frac{4400\text{ ft}}{\text{min}}\right][1\text{ min}] = \mathbf{4400\text{ ft}}$

8. MKS

10. $1000\text{ J}\left[\frac{0.7378\text{ ft-lb}}{1\text{ J}}\right] = \mathbf{737.8\text{ ft-lbs}}$

12. a. $\mathbf{10^4}$ b. 10^{-4} c. $\mathbf{10^3}$ d. $\mathbf{10^6}$ e. $\mathbf{10^{-7}}$ f. $\mathbf{10^{-5}}$

14. a. $4.2 \times 10^3 + 6{,}800 \times 10^3 = 6{,}804.2 \times 10^3 = \mathbf{6.8042 \times 10^6}$

b. $9 \times 10^4 + 0.36 \times 10^4 = \mathbf{9.36 \times 10^4}$

c. $50 \times 10^{-5} - 6 \times 10^{-5} = 44 \times 10^{-5} = \mathbf{4.4 \times 10^{-4}}$

d. $1.2 \times 10^3 + 0.05 \times 10^3 - 0.6 \times 10^3 = 0.65 \times 10^3 = \mathbf{6.5 \times 10^2}$

16. a. $(50 \times 10^3)(3 \times 10^{-4}) = 150 \times 10^{-1} = \mathbf{1.5 \times 10^1}$

b. $(2.2 \times 10^3)(8 \times 10^{-2}) = 17.6 \times 10^1 = \mathbf{1.76 \times 10^2}$

c. $(82 \times 10^{-6})(7 \times 10^{-5}) = 574 \times 10^{-11} = \mathbf{5.74 \times 10^{-9}}$

d. $(30 \times 10^{-4})(2 \times 10^{-4})(7 \times 10^8) = 420 \times 10^0 = \mathbf{4.2 \times 10^2}$

18. a. $\frac{2 \times 10^3}{8 \times 10^{-5}} = 0.25 \times 10^8 = \mathbf{2.5 \times 10^7}$

b. $\frac{4.08 \times 10^{-3}}{60 \times 10^3} = 0.068 \times 10^{-6} = \mathbf{6.8 \times 10^{-8}}$

c. $\frac{2.15 \times 10^{-4}}{5 \times 10^{-5}} = 0.43 \times 10^1 = \mathbf{4.3 \times 10^0}$

d. $\frac{78 \times 10^9}{4 \times 10^{-6}} = 19.5 \times 10^{15} = \mathbf{1.95 \times 10^{16}}$

20. a. $(2.2 \times 10^3)^3 = (2.2)^3 \times (10^3)^3 = 10.65 \times 10^9 = \mathbf{1.065 \times 10^{10}}$

b. $(6 \times 10^{-4} \times 10^2)^4 = (6 \times 10^{-2})^4 = (6)^4 \times (10^{-2})^4 = 1296 \times 10^{-8} = \mathbf{1.296 \times 10^{-5}}$

c. $(4 \times 10^{-3} \times 6 \times 10^2)^2 = (24 \times 10^{-1})^2 = (2.4)^2 = \mathbf{5.76}$

d. $((2 \times 10^{-3})(0.8 \times 10^{4})(0.003 \times 10^{5}))^3 = (4.8 \times 10^{3})^3 = (4.8)^3 \times 10^{3})^3$
$= 110.6 \times 10^{9} = \mathbf{1.106 \times 10^{11}}$

22. a. $\dfrac{(3 \times 10^{2})^2(10^{2})}{10^{4}} = \dfrac{(9 \times 10^{4})(10^{2})}{10^{4}} = \dfrac{9 \times 10^{6}}{10^{4}} = 9 \times 10^{2} = \mathbf{900}$

b. $\dfrac{(4 \times 10^{4})^2}{(20)^3} = \dfrac{16 \times 10^{8}}{8 \times 10^{3}} = \mathbf{9 \times 10^{12}}$

c. $\dfrac{(6 \times 10^{4})^2}{(2 \times 10^{-2})^2} = \dfrac{36 \times 10^{8}}{4 \times 10^{-4}} = \mathbf{9 \times 10^{12}}$

d. $\dfrac{(27 \times 10^{-6})^{1/3}}{21 \times 10^{4}} = \dfrac{3 \times 10^{-2}}{21 \times 10^{4}} = \mathbf{\dfrac{1}{7} \times 10^{-6}}$

e. $\dfrac{[(4 \times 10^{3})^2][300]}{2 \times 10^{-2}} = \dfrac{(16 \times 10^{6})(3 \times 10^{2})}{2 \times 10^{-2}} = \dfrac{48 \times 10^{8}}{2 \times 10^{-2}} = 24 \times 10^{10} = \mathbf{240 \times 10^{9}}$

f. $(16 \times 10^{-6})^{1/2}(10^{5})^5(2 \times 10^{-2}) = (4 \times 10^{-3})(10^{25})(2 \times 10^{-2}) = 8 \times 10^{20}$
$= \mathbf{800 \times 10^{18}}$

g. $\dfrac{[(3 \times 10^{-3})^3][7 \times 10^{-5}]^2[8 \times 10^{2}]^2}{[(10^{2})(9 \times 10^{-4})]^{1/2}} = \dfrac{(27 \times 10^{-9})(49 \times 10^{-10})(64 \times 10^{4})}{(9 \times 10^{-2})^{1/2}}$

$= \dfrac{84{,}672 \times 10^{-15}}{3 \times 10^{-1}}$

$= 28{,}224 \times 10^{-14} = \mathbf{282.24 \times 10^{-12}}$

24. a. $2000 \times 10^{-6}\ \text{s} = \underset{\text{increase by (3)}}{\underbrace{2.0 \times 10^{-3}}}\ \text{s} = \mathbf{2\ ms}$

b. $0.04 \times 10^{-3}\ \text{s} \Rightarrow \underset{\text{decrease by (3)}}{\underbrace{40 \times 10^{-6}}}\ \text{s} = \mathbf{40\ \mu s}$

c. $0.06 \times 10^{-6}\ \text{F} = \underset{\text{decrease by (3)}}{\underbrace{60 \times 10^{-9}}}\ \text{F} = \mathbf{60\ nF}$

d. $8400 \times 10^{-12}\ \text{s} \Rightarrow \underset{\text{increase by (6)}}{\underbrace{0.0084 \times 10^{-6}}}\ \text{s} = \mathbf{0.0084\ \mu s}$

e. $0.006 \times 10^3 \text{ m} = \underline{6000} \times 10^{-3} \text{ m} = \mathbf{6000 \text{ m}}$ (decrease by (6))

f. $260 \times \overbrace{10^3 \times 10^{-3}}^{10^0} \text{ m} \Rightarrow \underline{0.26} \times 10^3 \text{ m} = \mathbf{0.26 \text{ km}}$ (increase by (3))

26. a. $0.1 \,\mu\text{F}\left[\frac{10^{-6} \text{ F}}{1 \,\mu\text{F}}\right]\left[\frac{1 \text{ pF}}{10^{-12} \text{ F}}\right] = 0.1 \times 10^{-6} \times 10^{12} \text{ pF} = \mathbf{10^5 \text{ pF}}$

b. $0.467 \text{ km}\left[\frac{10^3 \text{ m}}{1 \text{ km}}\right] = \mathbf{467 \text{ m}}$

c. $63.9 \times 10^{-3} \text{ m}\left[\frac{100 \text{ cm}}{1 \text{ m}}\right] = 63.9 \times 10^{-1} \text{ cm} = \mathbf{6.39 \text{ cm}}$

d. $69 \text{ cm}\left[\frac{1 \text{ m}}{100 \text{ cm}}\right]\left[\frac{1 \text{ km}}{1000 \text{ m}}\right] = \mathbf{69 \times 10^{-5} \text{ km}}$

e. $3.2 \text{ h}\left[\frac{60 \text{ min}}{1 \text{ h}}\right]\left[\frac{60 \text{ s}}{1 \text{ min}}\right]\left[\frac{1 \text{ ms}}{10^{-3} \text{ s}}\right] = \mathbf{11.52 \times 10^6 \text{ ms}}$

f. $0.016 \text{ min}\left[\frac{10^{-3} \text{ m}}{1 \text{ min}}\right]\left[\frac{1 \,\mu\text{m}}{10^{-6} \text{ m}}\right] = 0.016 \times 10^3 \,\mu\text{m} = \mathbf{16 \,\mu\text{m}}$

g. $60 \text{ cm}^2 = 60(\text{cm})(\text{cm})\left[\frac{1 \text{ m}}{100 \text{ cm}}\right]\left[\frac{1 \text{ m}}{100 \text{ cm}}\right] = \mathbf{60 \times 10^{-4} \text{ m}^2}$

28. **5280 ft**, $5280 \text{ ft}\left[\frac{1 \text{ yd}}{3 \text{ ft}}\right] = \mathbf{1760 \text{ yds}}$

$5280 \text{ ft}\left[\frac{12 \text{ in.}}{1 \text{ ft}}\right]\left[\frac{1 \text{ m}}{39.37 \text{ in.}}\right] = \mathbf{1609.35 \text{ m}, 1.61 \text{ km}}$

30. $\frac{50 \text{ ft}}{20 \text{ s}}\left[\frac{1 \text{ mi}}{5280 \text{ ft}}\right]\left[\frac{60 \text{ s}}{1 \text{ min}}\right]\left[\frac{60 \text{ min}}{1 \text{ h}}\right] = \mathbf{1.7 \text{ mph}}$

32. $\frac{6 \text{ mi}}{\text{h}}\left[\frac{5280 \text{ ft}}{1 \text{ mi}}\right]\left[\frac{12 \text{ in.}}{1 \text{ ft}}\right]\left[\frac{1 \text{ m}}{39.37 \text{ in.}}\right]\left[\frac{1 \text{ h}}{60 \text{ min}}\right]\left[\frac{1 \text{ min}}{60 \text{ s}}\right] = \mathbf{2.682 \text{ m/s}}$

34. $10\ \cancel{\text{km}}\left[\frac{1000\ \cancel{\text{m}}}{1\ \cancel{\text{km}}}\right]\left[\frac{39.37\ \cancel{\text{in.}}}{1\ \cancel{\text{m}}}\right]\left[\frac{1\ \cancel{\text{ft}}}{12\ \cancel{\text{in.}}}\right]\left[\frac{1\ \text{mi}}{5280\ \cancel{\text{ft}}}\right] = 6.214\ \text{mi}$

$v = \frac{1\ \text{mi}}{6.5\ \text{min}}$, $t = \frac{d}{v} = \frac{6.214\ \cancel{\text{mi}}}{\frac{1\ \cancel{\text{mi}}}{6.5\ \text{min}}} = \mathbf{40.39\ min}$

36. 55 mph: $t = \frac{d}{v} = \frac{3000\ \cancel{\text{mi}}}{\frac{55\ \cancel{\text{mi}}}{\text{h}}} = \mathbf{54.55\ h}$

65 mph: $t = \frac{d}{v} = \frac{3000\ \cancel{\text{mi}}}{\frac{65\ \cancel{\text{mi}}}{\text{h}}} = \mathbf{46.15\ h}$

38. $d = 86\ \cancel{\text{stories}}\left[\frac{14\ \cancel{\text{ft}}}{\cancel{\text{story}}}\right]\left[\frac{1\ \text{step}}{\frac{9}{12}\ \cancel{\text{ft}}}\right] = 1605\ \text{steps}$

$v = \frac{d}{t} \Rightarrow t = \frac{d}{v} = \frac{1605\ \text{steps}}{\frac{2\ \text{steps}}{\text{second}}} = 802.5\ \cancel{\text{seconds}}\left[\frac{1\ \text{minute}}{60\ \cancel{\text{seconds}}}\right] = \mathbf{13.38\ minutes}$

40. $\frac{5\ \text{min}}{\text{mile}} \Rightarrow \frac{1\ \cancel{\text{mile}}}{5\ \text{min}}\left[\frac{5{,}280\ \text{ft}}{1\ \cancel{\text{mile}}}\right] = \frac{1056\ \text{ft}}{\text{minute}}$, distance $= 86\ \cancel{\text{stories}}\left[\frac{14\ \text{ft}}{\cancel{\text{story}}}\right] = 1204\ \text{ft}$

$v = \frac{d}{t} \Rightarrow t = \frac{d}{v} = \frac{1204\ \text{ft}}{1056\ \frac{\text{ft}}{\text{min}}} = \mathbf{1.14\ minutes}$

42. [6] [×] [(] [4] [+] [8] [)] [ENTER] $\Rightarrow$ **72.000**

44. [2nd] [$\tan^{-1}$] [(] [4] [÷] [3] [)] [ENTER] $\Rightarrow$ **53.13**